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RESULTS OF THE 1934 TREE-MEDICATION EXPERIMENTS IN WESTERN WHITE PINE

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INTRODUCTION

As a history of the tree-medication work in western white pine as well as an account of the 1934 experiments have been given in previous reports[1], this report will concern itself only with the results of the 1934 studies as shown by the examinations made during June 1935.

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(1)
Gibson, A. L. and Bedard, W. D. 1933. Tree medication as a control of the mountain pine beetle in western white pine.

Bedard, W. D. 1934. Additional information concerning tree medication as a control of the mountain pine beetle in western pine.

Bedard, W. D. 1934. Tree medication as a control of the mountain pine beetle in western white pine. 1934 investigations.

TABULATION OF RESULTS

The following eight tables show the mortality obtained in individual trees, and in each table these data are separated for each of the five poisons and the fifteen dosage groups.

TABLE I

AGE OF ATTACK Vs. MORTALITY IN MERCURIC CHLORIDE GROUP

Dosage	Tree No.	Age of attack in days							
		1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
1/2 oz.	89		90						
	98		33.3						
	104	100							
	121				0				
	124							100	
	129						0		
	142		100						
	159					0			
	160	0							
	161					60			
	162			44					
	163	0							
	172				0				
	178		0						
	179								0
2 oz.	1	5							
	6			0					
	7							0	
	9		25						
	45					10.7			
	50				50				
	56							28.8	
	79	0							
	92	100							
	109								100
	122		16						
	123								0
	127						0		
	133							0	
	136			0					

Continuation of TABLE I

Dosage	Tree No.	Age of attack in days 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
	31			98					
	32		77						
	43	25							
	71				0				
	90					0			
5 oz.	102	100							
	116								50
	117							100	
	128						0		
	134	100							
	135		100						
	137			0					
	139		100						
	140				0				
	141		100						
	15				75				
	51	85							
	57			0					
	82		46.2						
	103					54.4			
	118						100		
10 oz.	169	100							
	170		11						
	171								17
	173						0		
	174						0		
	175							3	
	176		10						
	177	37							
	180							20	

TABLE II

AGE OF ATTACK VS. MORTALITY IN ZINC CHLORIDE GROUP

Dosage	Tree No.	Age of attack in days 1-10	11-20	21-30	31-40	41-50	51-60	61-70
	10				0			
	11			48				
8 oz.	12	50						
	28		19					
	41						43.7	
	53					0		
	13							55
	16		100					
	42			0				
32 oz.	63							28.6
	64					95		
	65				100			
	138				49			

TABLE III

AGE OF ATTACK VS. MORTALITY IN COPPER SULPHATE GROUP

Dosage	Tree No.	1-10	11-20	21-30	31-40	41-50	51-60	61-70
	35				100			
	36	14						
	54			0				
4 oz.	76			33.3				
	80					38.3		
	83		50					
	33					100		
	34		100					
	46							100
8 oz.	52				100			
	61		100					
	74			91.8				
	21					56		
	22		12					
	44	100						
16 oz.	70			16.6				
	75				37.5			
	77							62.5

TABLE IV

AGE OF ATTACK VS. MORTALITY USING 4 OZ. SODIUM FLUORIDE

Tree No.	Age of attack in days						
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
17							48	
20					99			
49					10.5			
58			22.3					
78							0	
81	97.5							
91		0						
99				74.6				
105	100							
119						50		
120						100		
125				20				

TABLE V

AGE OF ATTACK VS. MORTALITY IN SODIUM ARSENATE GROUP

Dosage	Tree No.	Age of attack in days 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
	2				16.3					
	3							100		
	4		100							
	5	100								
	8					81.4				
	19			96						
	62								100	
	84				38.8					
4 oz.	106		95							
	107						100			
	108						38.6	38.6		
	126				46					
	131						50			
	143	100								
	144					100				
	146		100							
	152	100								
	156				100					
	157								100	
	158								99	
	14	100								
	23						100			
	27								73	
	47				100					
	48					95.8				
	55			100						
	73		78.2							
	100							47.7		
	110	100								
10 oz.	130						100			
	132					100				
	145		100							
	147			100						
	148						100			
	149					24				
	150				10.7					
	151									5
	153					100				
	154		100							
	155								100	

TABLE VI

AGE OF ATTACK VS. MORTALITY IN TREES INJECTED THROUGH THE ROOTS WITH 5-OZ. SODIUM ARSENATE

Tree No.	Age of attack in days							
	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80
18				50				
24	56							
25		72						
26			0					
30				93				
37		35.1						
38			87.9					
59	82.9							
60								99.4
67					100			
68							74.9	
69						98.6		
87								100
88					100			
93					0			
94		60						
95			100					
96				94.4				
97								
111		98.6						
112	100							
113		100						
114			0					
115					100			
164	100							

TABLE VII

AGE OF ATTACK VS. MORTALITY IN WINDFALLS

INJECTED WITH 5 OZ. SODIUM ARSENATE

	Tree No.	Age of attack in days							
		11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Tin Band	39					Logged off			
	40				No at.				
	66			0					
	72		0						
	85								0
	86								0
	183				0				
	185			0					
	186			0			0		
Root Injection	29							0	
	101					0			
	165		0						
	166			0					
	167						0		
	168	0							
	181				No at.				
	182		0						
	184				0				

TABLE VIII

AGE OF ATTACK VS. MORTALITY AVERAGES FOR ALL DOSAGES

Method	Dosage	No. trees treated	Average mortality in percent for various-aged attacks: 1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	Av. Mort.	Av. for Group
Saw-Kerf Tin-Collar	1/2 oz. Merc. Chloride	15	33.3	55.8	44	0	30	0	100	0		35.1	
	2 oz. Merc. Chloride	15	35.0	20.5	0	50	10.7	0	9.6	50		22.3	37.8
	5 oz. Merc. Chloride	15	75	94.2	49	0	0	0	100	50		56.6	
	10 oz. Merc. Chloride	15	74	33.4	0	75	54.4	33.3	11.5	17		37.2	
Collar Greased	8 oz. Zinc Chloride	6	50	19	48	0	0	43.7				26.8	45.1
	32 oz. Zinc Chloride	7		100	0	74.5	95		41.8			61.1	
	4 oz. Copper Sulphate	6	14	50	16.6	100	38.3					39.2	
	8 oz. Copper Sulphate	6		100	91.8	100	100		100			98.6	61.7
	16 oz. Copper Sulphate	6	100	12	16.6	37.5	56		62.5			47.4	
	4 oz. Sod. Fluoride	12	98.7	0	22.3	94.6	54.7	75	24			51.8	51.8
Saw-Kerf Tin-Collar	4 oz. Sod. Arsenate	20	100	98.3	96	50.2	90.7	75	69.3	100		83.0	82.3
	10 oz. Sod. Arsenate	20	100	92.7	100	55.3	79.9	100	47.7	86.5	5	81.7	
Root Injection Standing Trees	5 oz. Sod. Arsenate	25	84.7	72.9	46.9	79.1	75	98.6	74.9	66.4		72.0	72.0
Root Injection Windfalls	5 oz. Sod. Arsenate	9	0	0	0	0	0	0				0	0
Saw-Kerf-Tin Band Windfalls	5 oz. Sod. Arsenate	9		0	0	0	0	0		0		0	0
Averages*		168	71	68	42	50	60	56	47	64	5	57	

* 18 windfalls not included in this average

It will be seen in Table VIII that best results were secured in six trees which were treated with a solution of 8 ounces of copper sulphate dissolved in 3 quarts of water. However, it does not follow that all trees treated with this dosage will show such good results. Six trees could also be selected from either the mercuric chloride or sodium arsenate groups which would show equally high average mortalities. Hence, owing to the small number of trees dosed with 8 ounces of copper sulphate, it can only be said that this dosage gives excellent indications of success and should be tested further in future experiments.

Table VIII also indicates that there apparently is a minimum and maximum successful dosage in medicating white pine trees. It will be noted that the 5-ounce dose of mercuric chloride resulted in higher mortality than the 1/2-, 2- or 10-ounce doses of the same poison. Similarly, 8 ounces of copper sulphate gave better results than either the lower or higher dosages of this poison.

Table VI contains the data for those trees injected through the roots. This method of injection gave some excellent results and also some complete failures. In analysing the data for these trees there is no apparent reason for the high mortality in some trees and the very low mortality or complete lack of it in others. According to the number of roots injected per tree, one tree injected in 9 roots showed 0 mortality, 2 trees injected in 8 roots resulted in

71.9 percent mortality. 2 trees injected in 7 roots 47.2 percent, 5 trees in 6 roots 74.1 percent, 5 trees in 5 roots 53.6, 8 trees in 4 roots 95.7, and 2 trees injected in 3 roots showed 80 percent mortality. As in all other dosages, there are too few trees in this group to show a well-defined correlation and to permit a definite conclusion to be drawn.

Although in experiments conducted during past years there has always been a decided correlation between age of attack and mortality, the 1934 studies do not show this, owing to the fact that there are too few trees in each group and as a result some age classes are represented by only one tree.

In the following seven tables the mortality secured as a result of each of the various dosages is correlated with the diameter of the tree, intensity of attack, blue stain, insolation, exposure, and/hour of injection; and the averages for all trees in each correlation are given in Table XV. Additional correlations were made with temperature and humidity both in the form of curves and scattergraphs, but as no positive correlations were apparent and the curves were too cumbersome to handle in this report, they have been excluded.

TABLE IX

TREE DIAMETER VS. MORTALITY

TCG-Tin collar greased; TC-Tin collar; TBW-Tin band on windfall;
RI-Root injection; RIW-Root injection on windfall

Dosage and Method	No. Trees	Diameter breast high in inches									Av. Mort.	Av. for group
		6-8	9-11	12-14	15-17	18-20	21-23	24-26	27-29	30-32		
1/2 oz. Merc. Chl. TCG	15	100	100		0	28.9	0	60			35.1	
2 oz. Merc. Chl. TCG	15	0	0	0	75	26.5	0	0			22.3	37.8
5 oz. Merc. Chl. TCG	15		100	64	0	50	62	77			56.6	
10 oz. Merc. Chl. TCG	15			77.2	68	4	25	43	0		37.2	
8 oz. Zinc Chl. TCG	6			21.8			48	0	50	19	26.8	45.1
32 oz. Zinc. Chl. TCG	7				38.8			95	77	0	61.1	
4 oz. Cop. Sulph. TCG	6	33.3		14		50.1	46.1				39.2	
8 oz. Cop. Sulph. TCG	6	100	100	91.8			100	100			98.6	61.7
16 oz. Cop. Sulph. TCG	6		37.5	100	16.6			59.2		12	47.4	
4 oz. Sod. Fluo. TC	12	0		86	56	40		22.3	99		51.8	51.8
4 oz. Sod. Arsenate TC	20	100	100	79	78	98	67	90		96	83.0	82.3
10 oz. Sod. Arsenate TC	20		100		78	80	88	100		100	81.7	
5 oz. Sod. Arsenate RI	25	80	99.4	0	86	64.3	91			64	72.0	72.0
5 oz. Sod. Arsenate RIW	9										0	0
5 oz Sod. Arsenate TBW	9										0	0
TOTAL	186	593	636	1,215	1,611	2,134	1,882	1,040	304	355	9687	
AVERAGE*	168	66	79	60	59	53	55	61	50	50	57	

* 18 windfalls not included in this average.

TABLE X

INTENSITY OF ATTACK VS. MORTALITY

Dosage and Method	No. Trees	Number pitch tubes per square foot														Av. Mort.	Av. for group
		1	2	3	4	5	6	7	8	9	10	11	12	13	14		
1/2 oz Mer ChTCG	15	100	0			0	0	0	55.8	44		100	20			35.1	
2 oz Mer Ch TCG	15		0	25	18	28.8	0	0	10.7			100	38			22.3	
5 oz Mer Ch TCG	15	100			100	50	25		50	0		59			63	56.6	37.8
10 oz Mer Ch TCG	15		54.4	3	20	65.6	50		75	18	55	8			10	37.2	
8 oz Zinc Ch TCG	6			48	50	19	0		21.8							26.8	
32 oz Zinc ChTCG	7	100			49	100			95		55	0	28.6			61.1	45.1
4 oz Cop Sul TCG	6		25		38.3				100							39.2	
8 oz Cop Sul TCG	6	100	100	100		100	100						91.8			98.6	61.7
16oz Cop Sul TCG	6		37.5		100		14.3					59				47.4	
4 oz Sod Fl TC	12		11		74.6	48	20	10.5		50		99.5			100	51.8	51.8
4 oz Sod Ars TC	20		100	100	79.6	100	98	45.3	82	50				95	99	83.0	82.3
10 oz Sod Ars TC	20	100	100	100	5	62	47.7	100	100	73		55	78.2	100	95.8	81.7	
5 oz Sod Ars RI	25	100		100	56	0	74.7	0	66	0	84.6	97	93.6		67	72.0	72.0
5 oz Sod Ars RIW	9															0	0
5 oz Sod Ars TBW	9															0	0
TOTAL	186	600	564.2	576	786.7	981.8	756.7	346.8	1425.7	268	335.3	1236.2	842.6	194	466.9	9687	
AVERAGE*	168	100	47	72	52	54	42	35	65	30	67	65	60	97	58	57	

* 18 windfalls not included in this average.

TABLE XI

BLUE STAIN VS. MORTALITY

Dosage and Method	No. Trees	Percent blue stain										Av. Mort	Av. for group
		0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	
1/2 oz Mer Ch TCG	15	38.8				90						25.5	35.1	
2 oz Mer Ch TCG	15	30			25		0	10.7				22	22.3	
5 oz Mer Ch TCG	15	86				0						35	56.6	37.8
10 oz Mer Ch TCG	15	48		0	0			54.4	39			34	37.2	
8 oz Zinc Ch TCG	6	40										0	26.8	
32 oz Zinc Ch TCG	7	0		100	49							59	61.1	45.1
4 oz Cop Sul TCG	6		41		14							46	39.2	
8 oz Cop Sul TCG	6	97								100		100	98.6	61.7
16 oz Cop Sul TCG	6	100	12					16.6			37.5	59	47.4	
4 oz Sod Fl TC	12	65	22.3									50	51.8	51.8
4 oz Sod Ars TC	20	90		96		81.4						77	83.0	
10 oz Sod Ars TC	20	96								100		73	81.7	82.3
5 oz Sod Ars RI	25	70		98.6	80	100						67	72.0	72.0
5 oz Sod Ars RIW	9												0	0
5 oz Sod Ars TBW	9												0	0
TOTAL	186	3840.1	117.6	394.6	247.9	271.4	0	81.7	78	200	37.5	4423.1	9687	
AVERAGE*	168	67	29	78	41	67	0	27	39	100	37.5	53	57	

* 18 windfalls not included in this average.

TABLE XII

INSOLATION VS. MORTALITY

Dosage and Method	No. Trees	Insolation in tenths 0	2	3	4	5	6	7	8	9	10	Av. Mort.	Av. for group
1/2 oz Mercuric Chloride TCG	15	17						61	0		60	35.1	
2 oz Mercuric Chloride TCG	15	17									17	22.3	37.8
5 oz Mercuric Chloride TCG	15	50						0			65	56.6	
10 oz Mercuric Chloride TCG	15	20					100			20	76	37.2	
8 oz Zinc Chloride TCG	6	28									19	26.8	45.1
32 oz Zinc Chloride TCG	7	51									68	61.1	
4 oz Copper Sulphate TCG	6	39										39.2	
8 oz Copper Sulphate TCG	6	98					100					98.6	61.7
16 oz Copper Sulphate TCG	6	45									56	47.4	
4 oz Sodium Fluoride TC	12	36					74		0		67	51.8	51.8
4 oz Sodium Arsenate TC	20	84									81	83.0	82.3
10 oz Sodium Arsenate TC	20	82			10						87	81.7	
5 oz Sodium Arsenate RI	25	73	0	100	0				100		81	72.0	72.0
5 oz Sodium Arsenate RIW	9											0	0
5 oz Sodium Arsenate TBW	9											0	0
TOTAL	186	4771	0	100	10		274	123	200		3236	9687	
AVERAGE*	168	53	0	100	5		91	41	40		53	57	

* 18 windfalls not included in this average.

TABLE XIII

EXPOSURE VS. MORTALITY

Dosage and Method	No. Trees	Exposure										Av. Mort.	Av. for group
		North	NE	East	SE	South	SW	West	NW	Creek Bottom	Ridge Top		
1/2 oz Mercuric Chloride TCG	15	33		44	63.3		20	100	16.6			35.1	
2 oz Mercuric Chloride TCG	15		0		0	5	15	20.6	8.3	50	100	22.3	37.8
5 oz Mercuric Chloride TCG	15	100	0	87.5	50	0	25		75	50		56.6	
10 oz Mercuric Chloride TCG	15		11			49.6		25	37.3			37.2	
8 oz Zinc Chloride TCG	6							51	0		21	26.8	45.1
32 oz Zinc Chloride TCG	7					62	50	100	49			61.1	
4 oz Copper Sulphate TCG	6			50		44	23.5					39.2	
8 oz Copper Sulphate TCG	6			92		100		100	100			98.6	61.7
16 oz Copper Sulphate TCG	6		17		34		67					47.4	
4 oz Sodium Fluoride TC	12	75		22	49.5	5.5		74	75	20	98	51.8	51.8
4 oz Sodium Arsenate TC	20		75		79.6	98	100		78.7	46	16	83.0	82.3
10 oz Sodium Arsenate TC	20	48	58.7	78	66.8		100	98.6			100	81.7	
5 oz Sodium Arsenate RI	25	71.2	0		42.6	50			79.8	73.7		72.0	72.0
5 oz Sodium Arsenate RIW	9											0	0
5 oz Sodium Arsenate TBW	9											0	0
TOTAL	186	816	413	513	1158	822	1577	1233	1712	922	577	9687	
AVERAGE*	168	68	37.5	64.1	54.5	48.3	63	64.8	50	70.9	64.1	57	

* 18 windfalls not included in this average.

TABLE XIV

HOUR OF INJECTION VS. MORTALITY

Dosage and Method	No. Trees	Hour of Injection A.M. 8-8:59	9-9:59	10-10:59	11-11:59	12-12:59	P.M. 1-1:59	2-2:59	3-3:59	4-4:59	Av. Mort.	Av. for group
1/2 oz Mercuric Chloride TCG	15	50	20	0			22	100	33	100	35.1	
2 oz Mercuric Chloride TCG	15	1	17	100	25	0	16	32	0		22.3	37.8
5 oz Mercuric Chloride TCG	15	0	62	81		0	50	50	50	100	56.6	
10 oz Mercuric Chloride TCG	15	55	48	0	85	37		22			37.2	
8 oz Zinc Chloride TCG	6	44		19	0	24	50				26.8	45.1
32 oz Zinc Chloride TCG	7	0		100	29	95	100	55	49		61.1	
4 oz Copper Sulphate TCG	6		33			0	62	14			39.2	
8 oz Copper Sulphate TCG	6			100	100		100		92		98.6	61.7
16 oz Copper Sulphate TCG	6	56	69	30							47.4	
4 oz Sodium Fluoride TC	12	20	100	24	11	75	98	0	65		51.8	51.8
4 oz Sodium Arsenate TC	20	82	81	63	100			87	99		83.0	82.3
10 oz Sodium Arsenate TC	20	91	100	86	55	68	100	89	48		81.7	
5 oz Sodium Arsenate RI	25	86	66		50	56	90	63	0		72.0	72.0
5 oz Sodium Arsenate RIW	9										0	0
5 oz Sodium Arsenate TBW	9										0	0
TOTAL	186	1633	1407	1659	836	704	1114	1523	617	200	9687	
AVERAGE*	168	60.4	56.3	61.4	59.7	44	61.8	56.4	51.4	100	57	

* 18 windfalls not included in this average.

TABLE XV
AVERAGES FOR VARIOUS CORRELATIONS

Tree Diameter Vs. Mortality

Tree diam. in inches	6-8	9-11	12-14	14-17	18-20	21-23	24-26	27-29	30-32
No. trees	9	8	20	27	40	34	17	6	7
% mortality	66	79	60	59	53	55	61	50	50

Intensity of Attack Vs. Mortality

No. pitch tubes per square foot	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. trees	8	12	8	15	18	18	10	22	9	5	19	14	2	8
% mortality	100	47	72	52	54	42	35	65	30	67	65	60	97	58

Blue Stain Vs. Mortality

Percent blue stain:	0	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
No. trees	57	4	5	6	4	1	3	2	2	1	83
% mortality	67	29	78	41	67	0	27	39	100	37.5	53

Insolation Vs. Mortality

Insolation in tenths	0	2	3	4	5	6	7	8	9	10
No. trees	90	1	1	2		3	3	5		62
% mortality	53	0	100	5		91	41	40		53

Exposure Vs. Mortality

Exposure	North	NE	E	SE	South	SW	West	NW	Creek bottom	Ridge top
No. trees	12	11	8	21	17	25	19	34	13	9
% mortality	68	37.5	64.1	54.5	48.3	63	64.8	50	70.9	64.1

Hour of Injection Vs. Mortality

	A.M.						P.M.							
Hour	8-8:59	9-9:59	10-10:59	11-11:59	12-12:59	1-1:59	2-2:59	3-3:59	4-4:59					
No. trees	27	25	27	14	16	18	27	12	2					
% mort.	60.4	56.3	61.4	59.7	44	61.8	56.4	51.4	100					

It is apparent upon examination of the preceding seven tables that all correlations are negative owing to the fact that there are too few trees in each grouping. Similar tables were made using only the data for the 5-ounce dosage of mercuric chloride, 8-ounce dosage of copper sulphate, 4-ounce dosage of sodium fluoride, and the 4- and 10-ounce dosages of sodium arsenate. These correlations were also negative except in the case of that dealing with blue stain. Twenty-six trees showing no blue stain at the time of injection had an average mortality of 58.5 percent, while 41 trees which were blued over their total circumference at the time of injection showed an average mortality of 64.6 percent. In only a few trees was there any visual checking of blue-stain development following injection, and this occurred only in trees in which 100 percent brood mortality had been obtained. Neither was the checking of blue-stain development restricted to any particular poison. It was far more common to find blue stain in trees which had shown no visual blue stain at the time of injection than it was to find trees in which blue stain had been checked.

RECOMMENDATIONS FOR FUTURE WORK

It is regretted that so little positive information was gained from the 1934 injections; however, it does serve to show that too many problems of tree injection can not be solved during one season's work, owing to the fact that with so many factors to consider there are too few trees representing each factor or set of factors. If money is available for a continuation of this project during 1935, it is recommended that the study be planned as a regular control project and that most of the trees be medicated with an 8-ounce dosage of sodium arsenate dissolved in 4 quarts of water, using the saw kerf-tin collar method. Tree data, the same as those taken in 1934, will be recorded for each tree. In this way a sufficient number of trees will be available to represent each set of factors so that certain factors can be eliminated as unimportant and the remainder can be accepted as critical factors influencing the success of medication. The data can then be arranged in a table which can be used as a basis to calculate the success which may be expected from injecting a tree representing a certain set of physiological and environmental factors. With this table, then, the success of tests made with various poisons, methods of injection, dosages, etc., can be determined.

In addition to the above injections, as many trees as possible should be injected, during 1935, with an 8-ounce dosage of copper sulphate dissolved in 4 quarts of water, using the saw kerf-tin collar method of injection.

Respectfully submitted

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